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TEMPERATURE MEASUREMENT IN CRITICALLY ILL PATIENTS A COMPARISON OF PULMONARY ARTERY CORE AND TYPANIC

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ABSTRACT

OBJECTIVE: Core temperature measurement using a pulmonary artery catheter is considered the gold standard for measuring temperatures in critically ill patients. Our objective was to compare oral and tympanic temperature measurements against pulmonary artery core temperature measurements in order to determine which method was most accurate and reliable in the absence of a pulmonary artery catheter.

DESIGN: Prospective, descriptive comparative analysis.

PATIENTS: Convenience sample of 102 critically ill, orally intubated patients with a pulmonary artery catheter in place.

SETTING: 24-bed medical/surgical/trauma intensive care unit in a university-affiliated medical center.

INTERVENTIONS: Four experienced ICU nurses were trained in the use of temperature measurement using the oral, tympanic (both core and oral equivalence modes were used) and pulmonary artery core methods. Simultaneous temperature measurements were then taken once in each subject using each method. The potential covariates that were analyzed were: mean blood pressure, patient acuity using SAPS II, age, sex, ambient room temperature, and ventilator circuit temperature.

MEASUREMENTS AND MAIN RESULTS: The training period indicated that it took more time to train experienced nurses in the use of tympanic thermometry than oral thermometry. Descriptive statistics illustrated the following: core ($\bar{x}=37.33$, $SD=0.89$), oral ($\bar{x}=37.18$, $SD=0.92$), tympanic oral ($\bar{x}=36.80$, $SD=0.93$), tympanic core ($\bar{x}=37.12$, $SD=1.0$). Bias averages were calculated and were significantly different from zero for all three methods (oral-core: -0.15 , $SD=0.36$; tympanic core-core: -0.11 , $SD=0.57$; tympanic oral-core: -0.52 , $SD=0.53$), indicating that there is some degree of decreased accuracy associated with each method when compared to pulmonary artery core. However, scatter plots using Bland and Altman methodology illustrate that the greatest variability is associated with the tympanic method.

CONCLUSIONS: Temperature measurement is an important piece of clinical data in a critically ill patient population. We found oral thermometry to be the most accurate and reproducible method when a pulmonary artery core measurement is not available.

METHODS

SUBJECTS

- Convenience sample (N=102, 54 males and 48 females).
- Critically ill, orally-intubated patients admitted to 24-bed medical/surgical/trauma ICU.
- PA catheter already in place.
- **Variables:** age, diagnosis, blood pressure, SAPS II, ambient room temperature, ventilator circuit temperature.
- **Diagnosis:** 23.5% abdominal surgery, 21.5% vascular surgery, 21.5% respiratory failure, 9.8% sepsis, 6.8% trauma.

TEMPERATURE MEASUREMENT

- All devices calibrated using black-body device prior to initiation of study.
- Data collected simultaneously by two data collectors.
- Ambient and ventilator circuit temperatures recorded.
- PA thermistor checked for accuracy using HP electronic temperature simulator.
- Oral temperature probe (WelchAllyn SureTemp) placed in either right or left posterior sublingual pocket.
- Tympanic temperature (First Temp Genius II).
 1. Otoloscopic ear exam to visualize TM
 2. Two minute waiting period
 3. Temperatures taken in right ear only
 4. One temperature in oral equivalence mode and one in core equivalence mode, with a two minute waiting period in between

EXCLUSION

- Oral abscess/trauma
- Within 30 minutes of mouth care
- Head trauma
- Inability to visualize TM

RESULTS

1. Covariate analysis indicated no significant relationships between any of the three thermometry methods and any of the covariates (Table 1).
2. Descriptive statistics (Table 2 & 3).
3. Bland and Altman variability (Figures 1, 2 & 3).

INTERATER RELIABILITY

- Data collected by four experienced ICU nurses
- Comprehensive pre-study training program
- Interater reliability testing done

Thermometer	Collector 1 Mean (Std)	Collector 2 Mean (std)	Collector 3 Mean (std)	Collector 4 Mean (std)
Oral	97.5 (0.1)	97.5 (0.0)	97.4 (0.1)	97.4 (0.1)
Tympanic	95.8 (1.2)	96.5 (0.1)	96.5 (0.1)	96.5 (0.1)

Implications for Practice/Future Research

- Recommend oral method as it is much easier, requires less training time, and is associated with less variability than tympanic method.
- Tympanic method very dependent on operator technique.
- Future studies should include more hypothermic and hyperthermic patients.

PURPOSE

To compare oral and tympanic temperature measurement methods against pulmonary artery core measurements to determine the relative efficacy of these methods in a critically ill, orally intubated patient sample.

ORALLY ILL ORALLY INTUBATED ADULTS: CORE, TYMPANIC, AND ORAL METHODS

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TABLE 1

COVARIATE ANALYSIS (SAS VERSION 6.12)

<i>ORAL_COR</i>				
Parameter	Estimate	T for H0: Parameter=0	p-values	Std Error of Estimate
INTERCEPT	0.6998	1.38	0.1716	0.5076
AGE	-.0061	-1.22	0.1293	0.0127
ROOMTEMP	-.0015	-0.21	0.8343	0.0071
VENTCTEM	-.0077	-0.67	0.5063	0.0116
SAPSCORE	-.0002	-0.09	0.9260	0.0025
MEANBP	-.0018	-0.83	0.4083	0.0022
<i>TYMC_COR</i>				
Parameter	Estimate	T for H0: Parameter=0	p-values	Std Error of Estimate
INTERCEPT	0.4212	-0.49	0.6272	0.8635
AGE	-.0019	-0.41	0.6794	0.0046
ROOMTEMP	-.0044	-0.38	0.7028	0.0115
VENTCTEM	0.0153	0.79	0.4311	0.0195
SAPSCORE	0.0046	1.11	0.2713	0.0042
MEANBP	-.0023	-0.64	0.5256	0.0036
<i>TYMO_COR</i>				
Parameter	Estimate	T for H0: Parameter=0	p-values	Std Error of Estimate
INTERCEPT	0.3740	0.50	0.6181	0.7475
AGE	-.00637	-1.57	0.1206	0.0041
ROOMTEMP	-.00505	-0.47	0.6370	0.0106
VENTCTEM	-.01846	-1.08	0.2853	0.0172
SAPSCORE	0.0053	1.43	0.1571	0.0037
MEANBP	0.0004	0.11	0.9128	0.0032

TABLE 2

Thermometry	N	Mean	Std Deviation	Min	Max
Core	102	37.33	0.89	34.5	39.5
Oral	102	37.18	0.92	34.39	39.5
Tymp Core	87	37.12	1.0	34.67	39.67
Tymp Oral	102	36.80	0.93	34.33	39.0

TABLE 3

Bias Variable	Mean	Std Deviation	Min	Max	Significance
Oral-Core	-0.15	0.36	-1.77	1.59	.0001
Tymp Core-Core	-0.11	0.57	-1.96	1.1	.0795
Tymp Oral-Core	-0.52	0.53	-2.34	0.33	.0001

FIGURE 1

SURE TEMP ORAL THERMOMETER BIAS

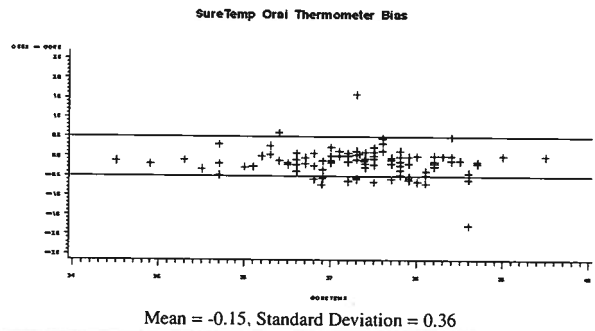


FIGURE 2

GENIUS TYMPANIC THERMOMETER, CORE MODE, BIAS

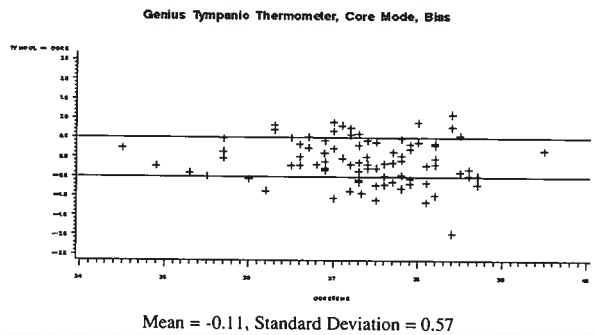


FIGURE 3

GENIUS TYMPANIC THERMOMETER, ORAL MODE, BIAS

